Savannah River Site

GeoSiphon / GeoFlow Cells

Mark A. Phifer

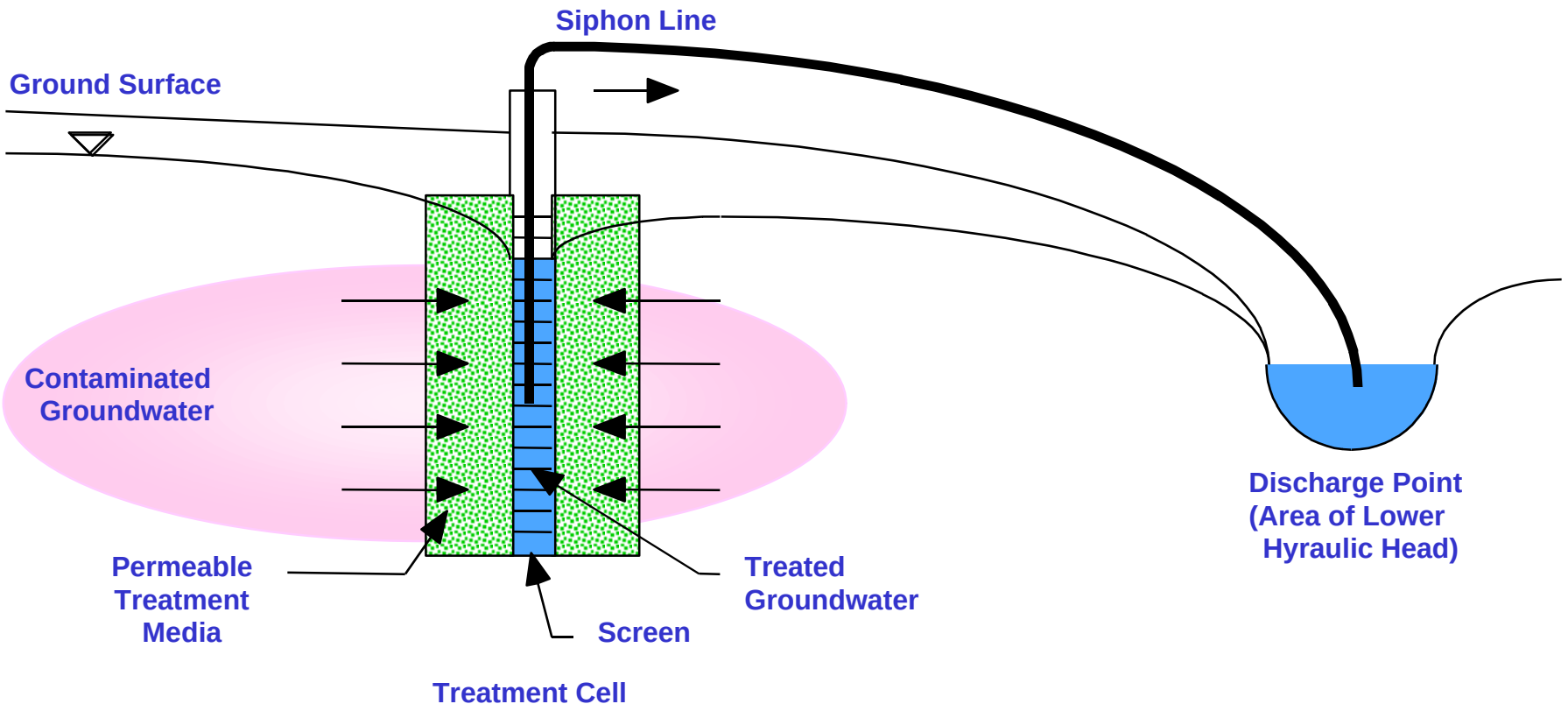
Environmental Sciences & Technology

Savannah River Technology Center

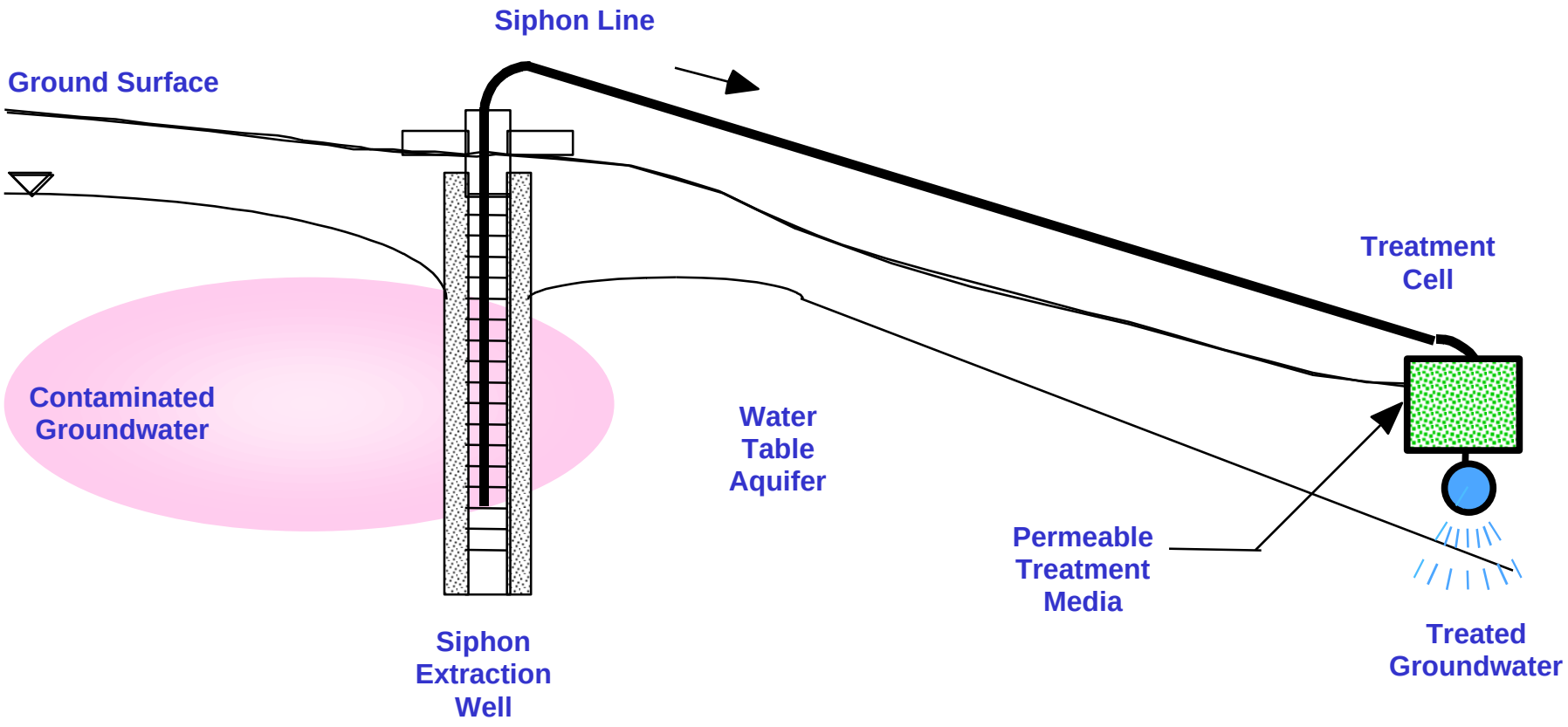
GeoSiphon / GeoFlow Cells

- **GeoSiphon / GeoFlow Cells are systems that passively induce contaminated groundwater flow through permeable treatment media at an accelerated rate by utilizing the natural hydraulic head difference between two points:**
  - **GeoSiphon utilizes a siphon to induce flow**
  - **GeoFlow utilizes open channel and/or pressure flow**
- **The permeable treatment media can be configured to be:**
  - **In Situ or Ex Situ**
  - **Removable or permanent**

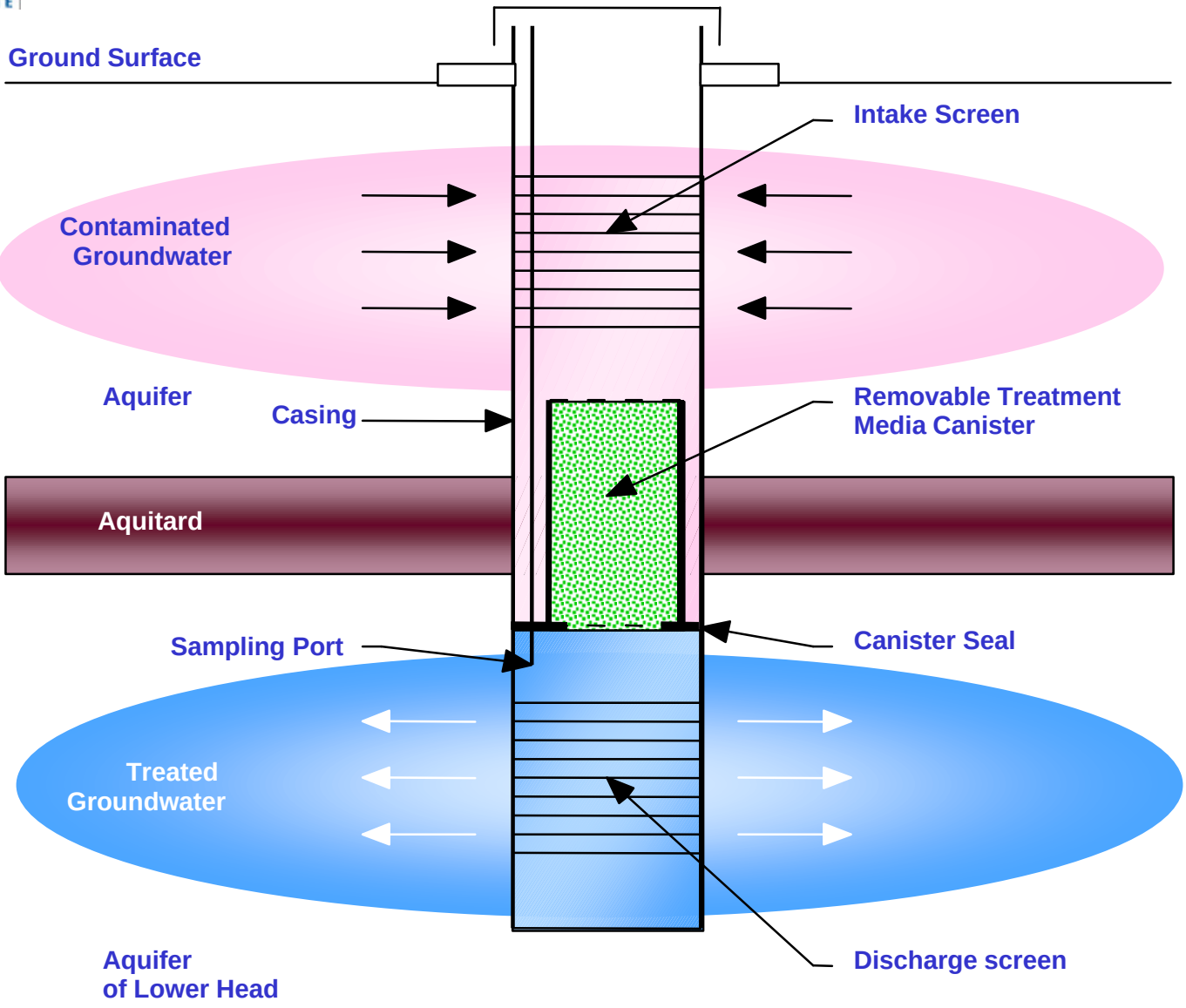
GeoSiphon Cell



GeoSiphon Cell



GeoFlow Cell



Potential Permeable Treatment Media

Media	Contaminant
Granular Cast Iron, Iron Foam, Bimetallics (Pd/Fe, Cu/Fe)	Chlorinated Organics, Metals (Cr^{+6}), Radionuclides (U)
Activated Carbon	Organics
Zeolites	Metals (Cd, Cu, Pb) Radionuclides (Cs,Sr)
Peat	Metals (Cd, Cu, Pb)
Limestone	Metals (Al, Fe)
Phosphate Rock	Metals (Cd, Pb) Radionuclides (Sr)
Carbon Source / Sulfate Reducers (Bacteria)	Metals (Fe) Sulfate

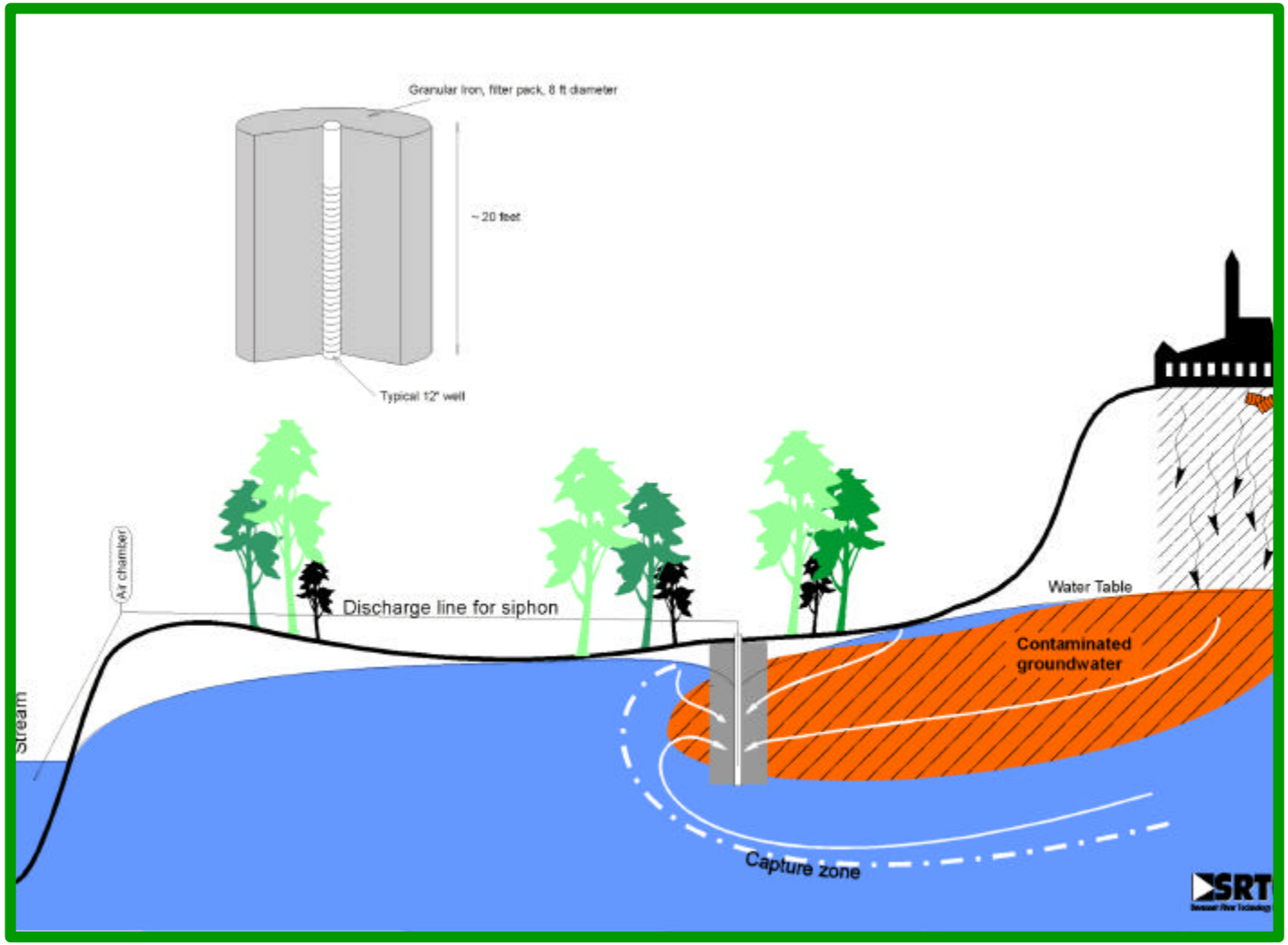
Potential GeoSiphon / GeoFlow Cell Advantages

- **Over Pump & Treat**
  - In Situ
  - Passive (no power requirements)
  - Significantly lower operating & maintenance costs
- **Over Funnel & Gate and Continuous Permeable Wall**
  - Use an existing foundation installation or well drilling technique
  - Induced flow may be greater than natural flows (i.e, accelerated clean up)
  - Applicable to a wider range of site conditions

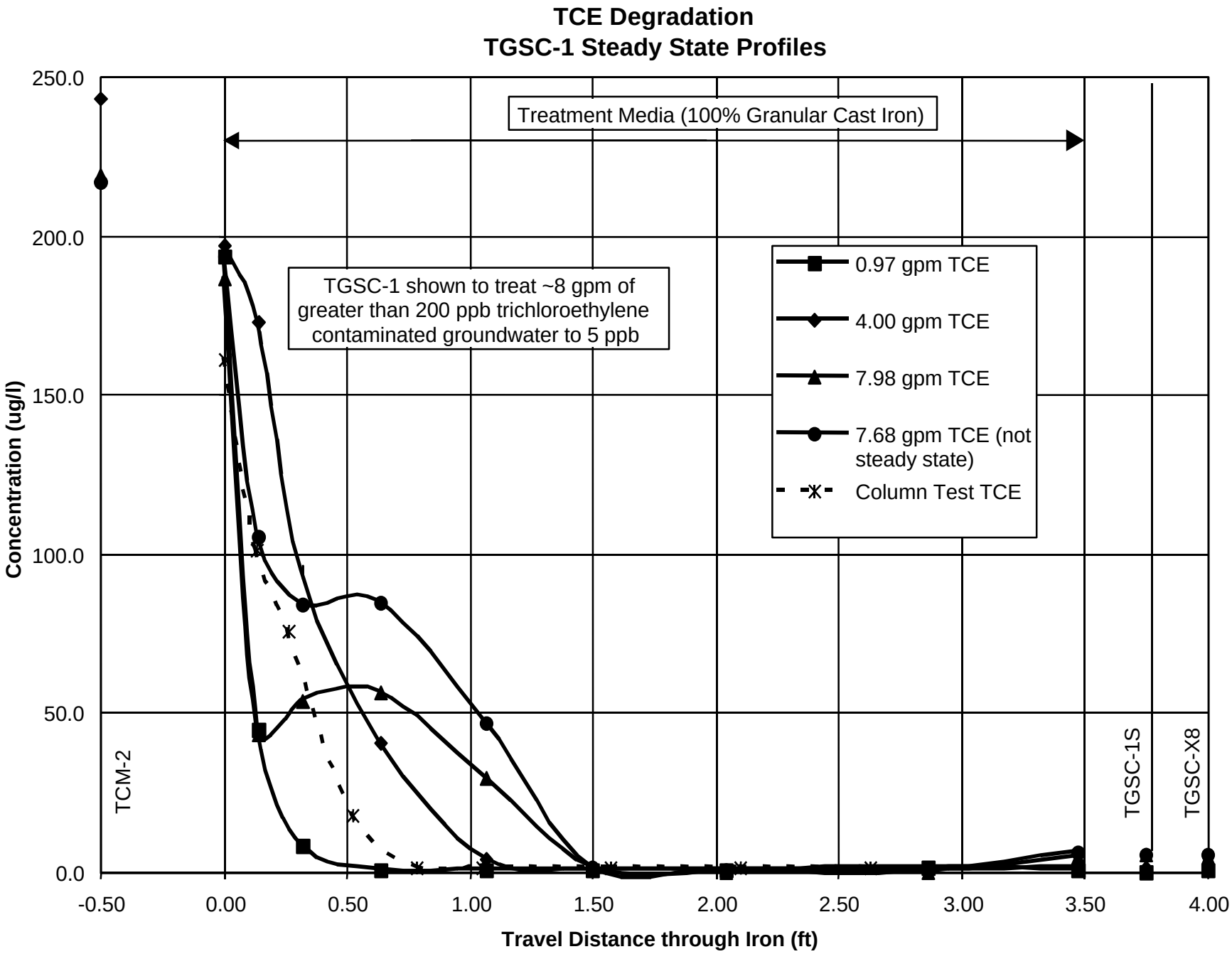
Current SRS Technology Application
TNX GeoSiphon Cell Description

- Essentially a large diameter well (8 ft.)
- Installed by Auger and Caisson method
- Granular cast iron replaces the gravel pack
- Siphon established with the X-08 Outfall Ditch (lower head)
- Siphon induces flow through iron filings where treatment occurs
- Treated groundwater discharged to the X-08 Outfall Ditch which flows into the Savannah River

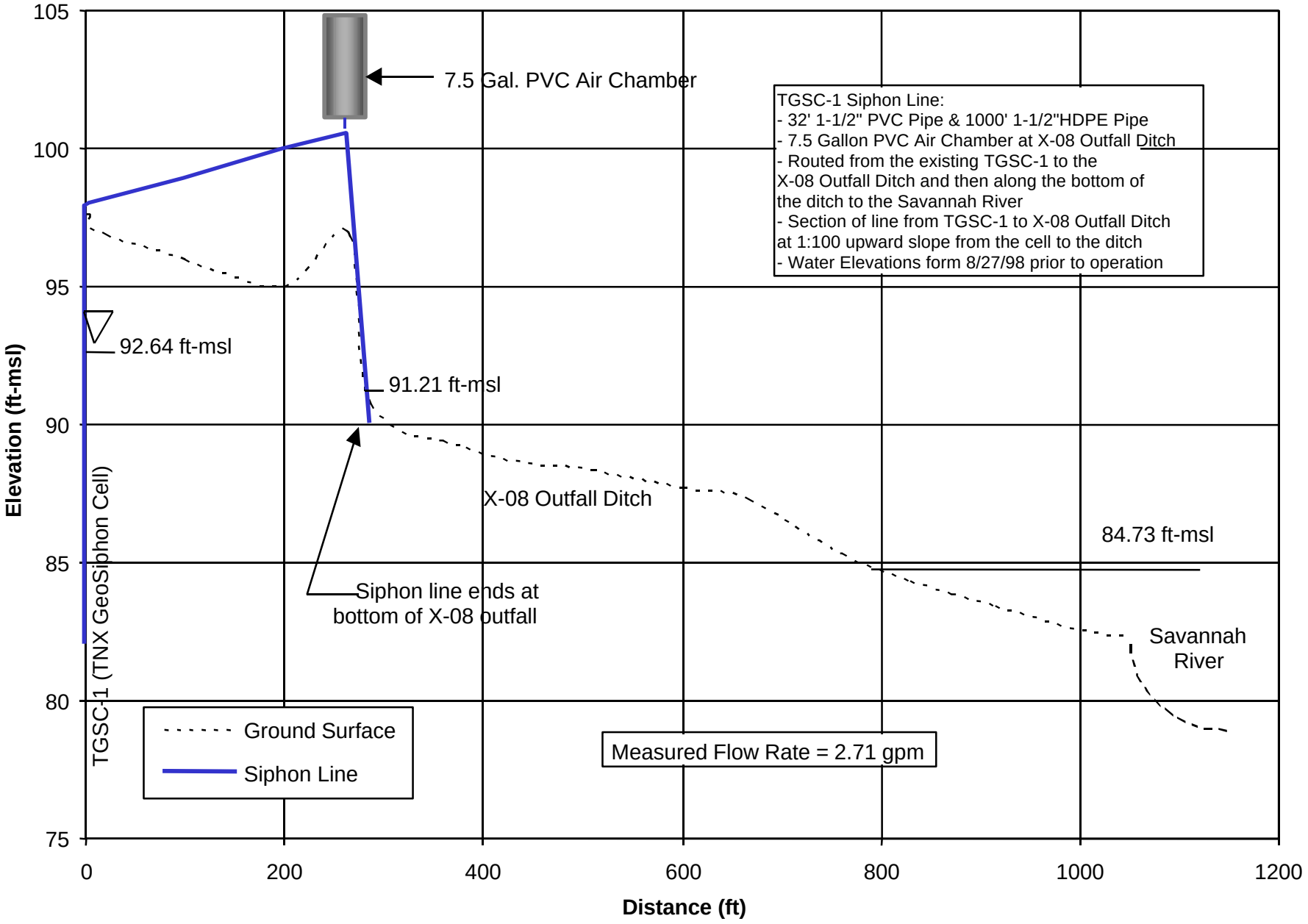
TNX GeoSiphon Groundwater Treatment System



TNX GeoSiphon Groundwater Treatment System


TCE Degradation
TGSC-1 Steady State Profiles
Treatment Media (100% Granular Cast Iron)
TGSC-1 shown to treat ~8 gpm of greater than 200 ppb trichloroethylene contaminated groundwater to 5 ppb
0.97 gpm TCE
4.00 gpm TCE
7.98 gpm TCE
7.68 gpm TCE (not steady state)
Column Test TCE
Concentration (ug/l)
250.0
200.0
150.0
100.0
50.0
0.0
-0.50
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
Travel Distance through Iron (ft)
TCM-2
TGSC-1S
TGSC-X8

TGSC-1 Siphon Line Profile
Air Chamber at X-08 and 305 Foot Line



Technology Application

- Applicable to any contaminant for which an appropriate permeable treatment media is available
- Requires at least a few foot head differential
- GeoSiphon is applicable to primarily shallow groundwater (maximum siphon lift of 25')
- GeoFlow depth only limited by installation equipment limitations (i.e, drilling / augering rigs, etc.)
- International patent application filed on 12/17/97 by Westinghouse Savannah River Company (WSRC)
- WSRC currently seeking commercial licensees for the technology